TEXAS TECH UNIVERSITY™

West Texas LMA

Operational and Research Use

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Atmospheric Science Group

Contributors: Vanna Sullivan, Jennifer Daniel, Steve Cobb, Jason Jordan, Joe Jurecka, Camaron Plourde, Stephanie Weiss, Jerry Guynes, Paul Krehbiel, Bill Rison, Ron Thomas

GLM Science Meeting, Huntsville, AL
19-21 September, 2012

West Texas LMA

WTLMA installation at New Deal High School

West Texas LMA

- First data
  21 Nov 2011

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- Continuous
  collection
  18 Feb 2012

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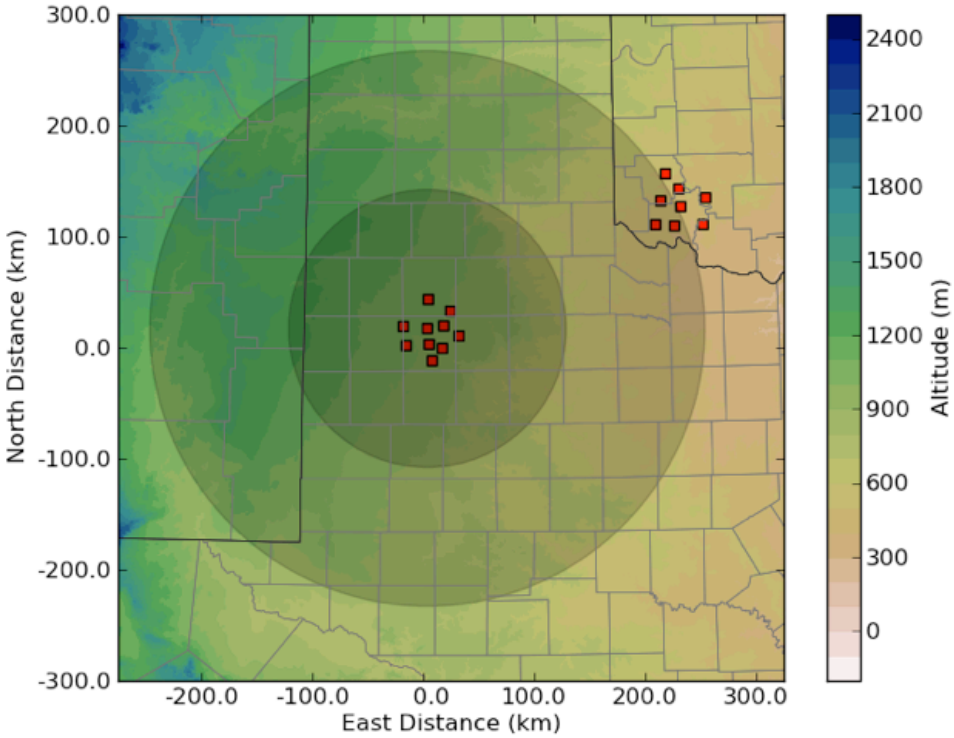
- 10th station
  25 May 2011

WTLMA installation at New Deal High School

West Texas LMA

- First data 21 Nov 2011
- Continuous collection 18 Feb 2012
- Real-time, 9 stations 25 April 2012
- 10th station 25 May 2011

Current coverage



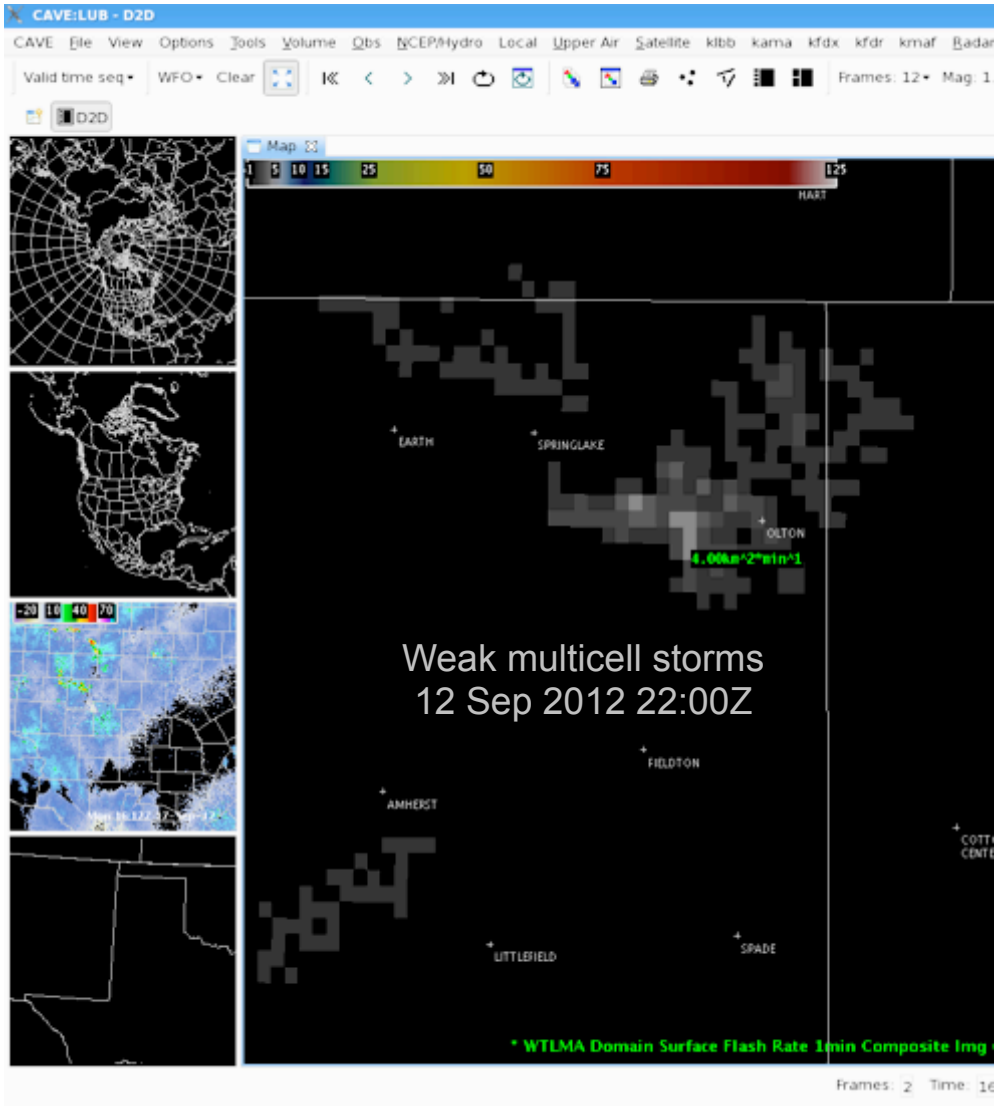
DATA PROCESSING AND DELIVERY

- All sites accessible by internet
  - *Seven 5.8 GHz (802.11a) links. Three cell modems.*
- LMA processor / RAID at TTU's 24/7 central server facility
  - *Just added new RAID*
- Trial of co-processing with OKLMA will happen this fall

- Website: *http://pogo.tosm.ttu.edu/wtlma/*
- 1 min aggregate ASCII data supplied through TTU LDM feed to SRH/NWS Lubbock, NSSL HWT, SPoRT
  - *Contributes to National Lighting Jump Field Test*
- VHF source data streamed over http to NMT's LiveLMA display
  - *1 s latency (flash, display, hear)*
  - *Includes broadcast within LUB forecast office (internal plumbing by Joe Jurecka)*

WTLMA DATA IN AWIPS II AT WFO LUB

- 1 km, 1 min grids
  - *Flash extent*
  - *Flash initiation*
- AWIPS-II-ready products produced by NSSL / HWT
  - *(Kristin Calhoun and Darrel Kingfield)*
- Ingest and display works
  - *(Jason Jordan, LUB)*
- Waiting on SRH to forward products to LUB for real-time display



LUBBOCK FORECAST OFFICE INTERACTION

- COMET / GOES-R project with Lubbock NWS office
  - *Develop and provide training (J. Daniel)*
    - Module 1: Electrification and charge structure expectations relative to sub-cell storm structure: controls flash rate and extent
    - Module 2: Principles and expectations for use of LMA data in operations
    - Operations cheat sheet on floor near workstations for quick reference on interpretation
  - *Hands-on support of LiveLMA*
    - Worked two storm cases in office with LUB WFO staff
    - Conference call with surrounding offices: interest in total lightning data
      - Provided WTLMA access instructions
  - *Post-event discussions with LUB staff (successes next…)*

OPERATIONAL SUCCESSES

- Key benefits to LUB office:
  - *Lead time: 5-10 min in recognizing new cells*
    - (e.g., embedded underneath anvils)
  - *Storm process thinking for warning operations:*
    - Recognition of new updrafts and updraft modulation in multicellular and supercellular convection
  - *Public safety: Decision Support*
    - large events, airfield safety, emergency management, etc.
- 4 June 2012: AWIPS failure at LUB during severe wx
  - *"WTLMA data was used for a time as a primary source in warning-decisions while our backup office was getting spun up on the event. Throughout the remainder of the evening while radar data was being restored, total lightning data was used to alert the backup office of where new convection of interest was developing and to assist them in the warn-don't-warn process. The LMA once again provided some very helpful information in the short-term convective trends and certainly was a very valuable tool. The data was also used for [Decision Support] purposes to alert a Vacation Bible School group at Calvary Baptist which had a large group of outdoor activities going on in the evening." - Steve Cobb*
- Public outreach
  - *Intro to total lightning data at 2011 NWS Lubbock aviation weather workshop. Another one coming up this October.*

LUBBOCK FORECAST OFFICE PRESENTATIONS WITH WTLMA DATA AT SLS, AMS CONFERENCES

Cobb, S., J. Jordan, E. Bruning, and J. Daniel, 2012: Early results of operational use of total lightning data from the West Texas Lightning Mapping Array. *26th Conference on Severe Local Storms, Nashville, TN*

Conder, M. R., S. Cobb, G. Skwira, E. Bruning, and J. Daniel, 2012: Multi-sensor observations and analysis of the 14-15 June, 2012 heat bursts in the Texas Panhandle. *26th Conference on Severe Local Storms, Nashville, TN*

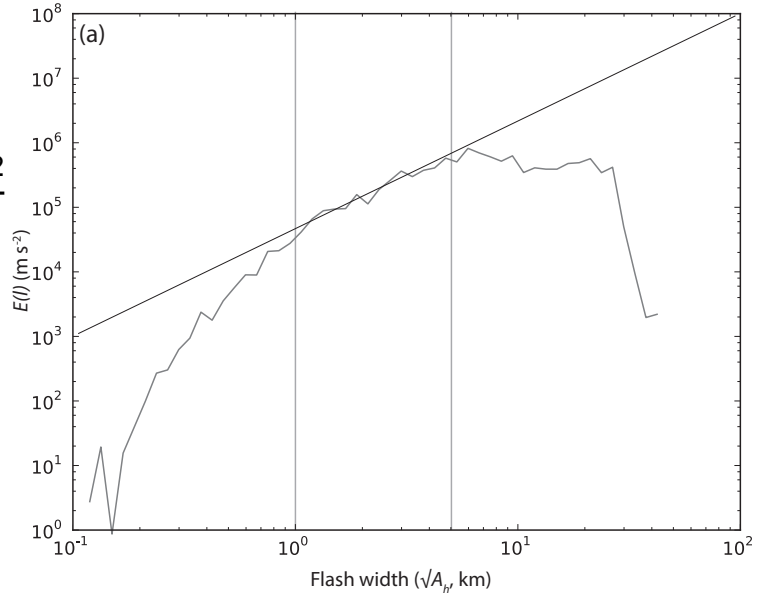
Daniel, J., E. Bruning, S. Cobb, J. Jordan, and J. W. Jurecka: Operational Trials of Total Lightning Data and Training at NWS Lubbock Forecast Office, *6th Conference on the Meteorological Applications of Lightning Data, Austin, TX*

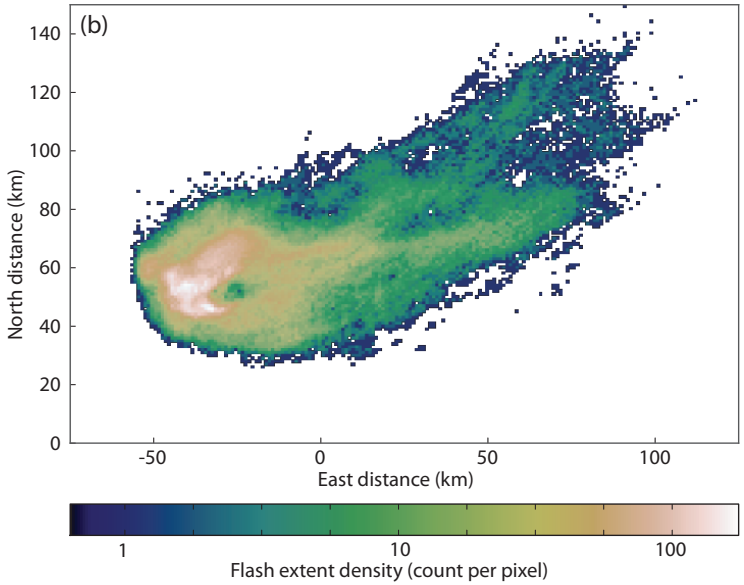
ENERGETIC SCALING IN THE FLASH SIZE SPECTRUM: RELEVANT QUANTITIES FOR TOTAL LIGHTNING PRODUCTS

$\frac{\text{area} * \text{rate}^2}{\text{bin width}}$

vs.

√ area

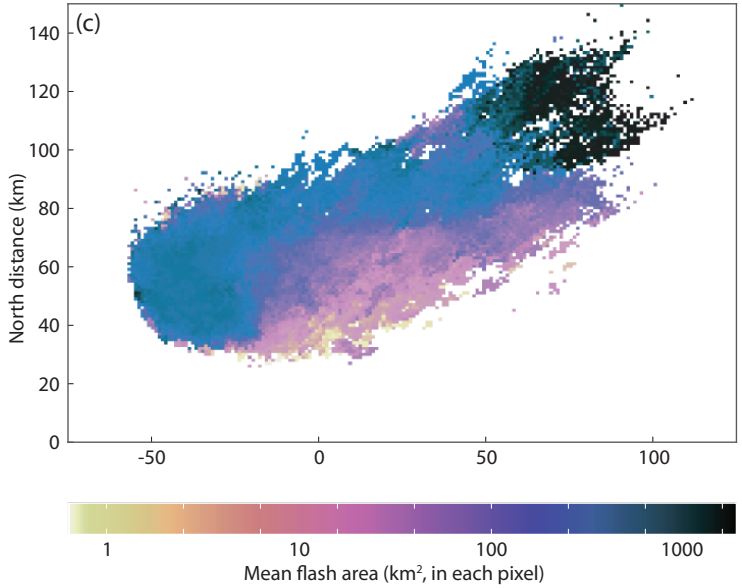


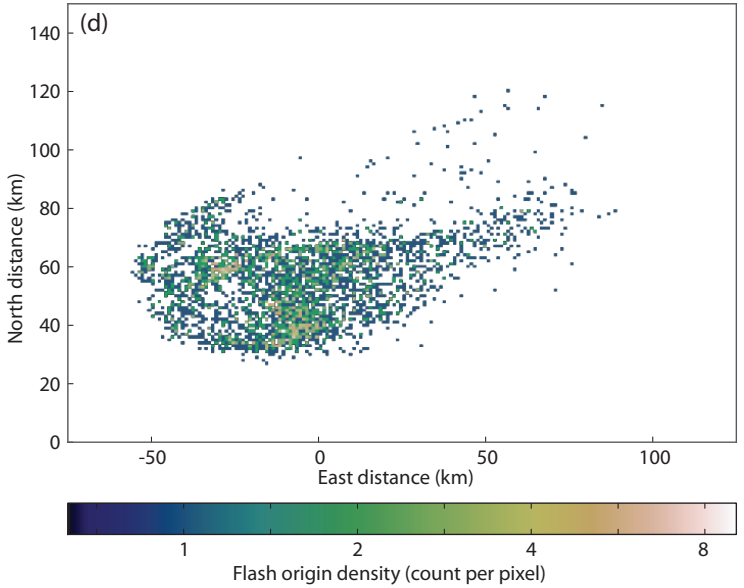


Flash extent density

Average area

(new product idea for ops trials)





Flash initiation density

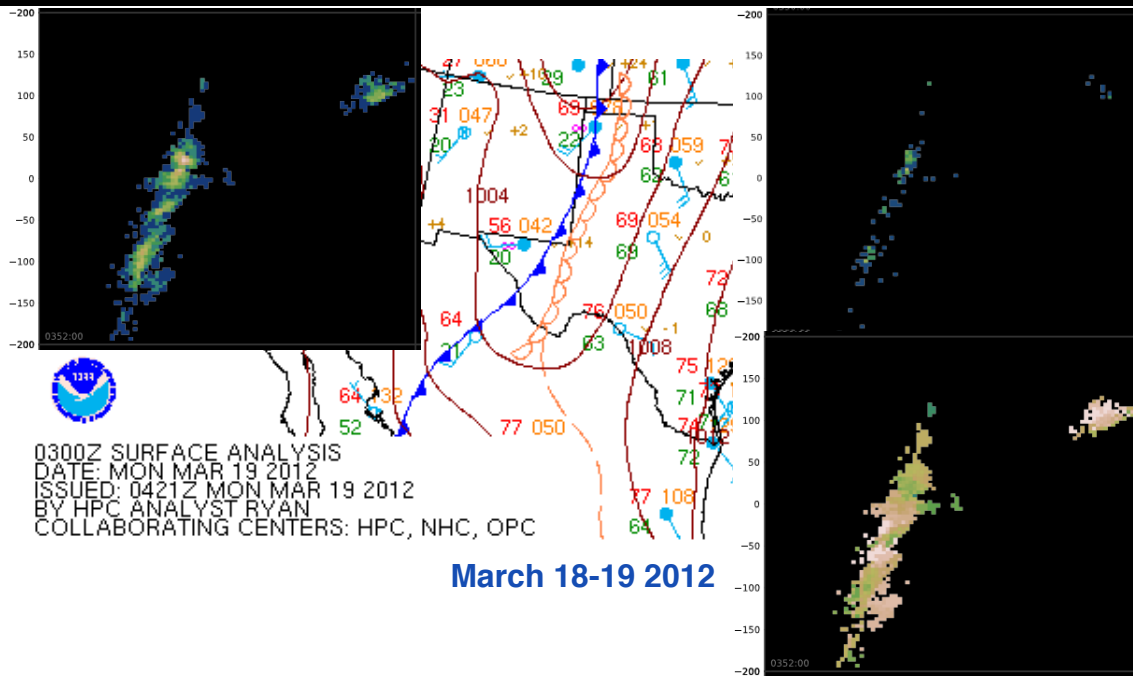
DC3: Flash length estimates from flash area

- Use fractal dimension ***D*** to estimate flash length from flash area (or volume?)
- Inspired by fractal dimension estimates using the traditional box-counting method (Theiler, 1990, *J. Optical Soc. Am.*)
  - *Power-law relationship between number of small and large boxes that are needed to cover an object*
  - *Flash-spanning area* $\boldsymbol{A_h}$ *is largest box*
  - *Channel step length* $\boldsymbol{b_s}$ *is smallest sensible box*
- Length estimate ***L*** is:

$$L = N_s b_s = b_s \left(\frac{\sqrt{A_h}}{b_s} \right)^D = \frac{(\sqrt{A_h})^D}{(b_s)^{D-1}}$$

- Computationally efficient: only need hull area
- Initial comparison with Ron Thomas's connect-the-dots estimates and box coverage method shows promise
  - *More at AGU, AMS annual*

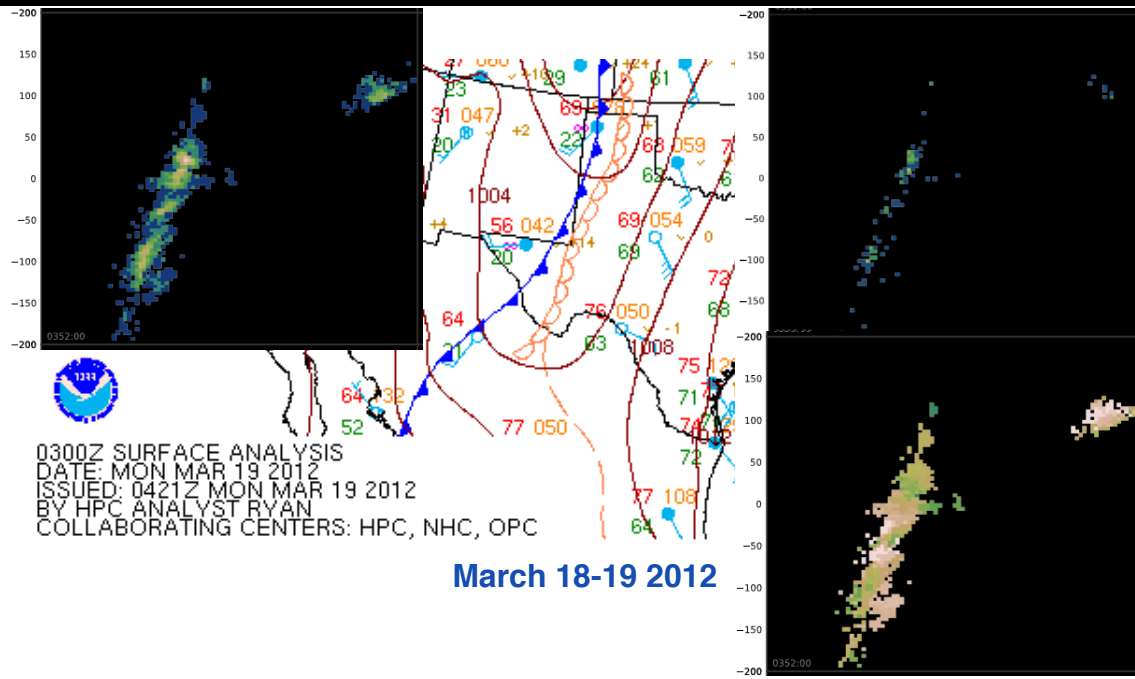
LIGHTNING AND METEOROLOGY: CASE STUDIES



March 18-19 2012

LIGHTNING AND METEOROLOGY: CASE STUDIES

- QLCS as cold front overtook dryline
  - *weak tornadic spinups in one cell*
  - *signals in flash rate, extent?*
  - *(C. Plourde)*



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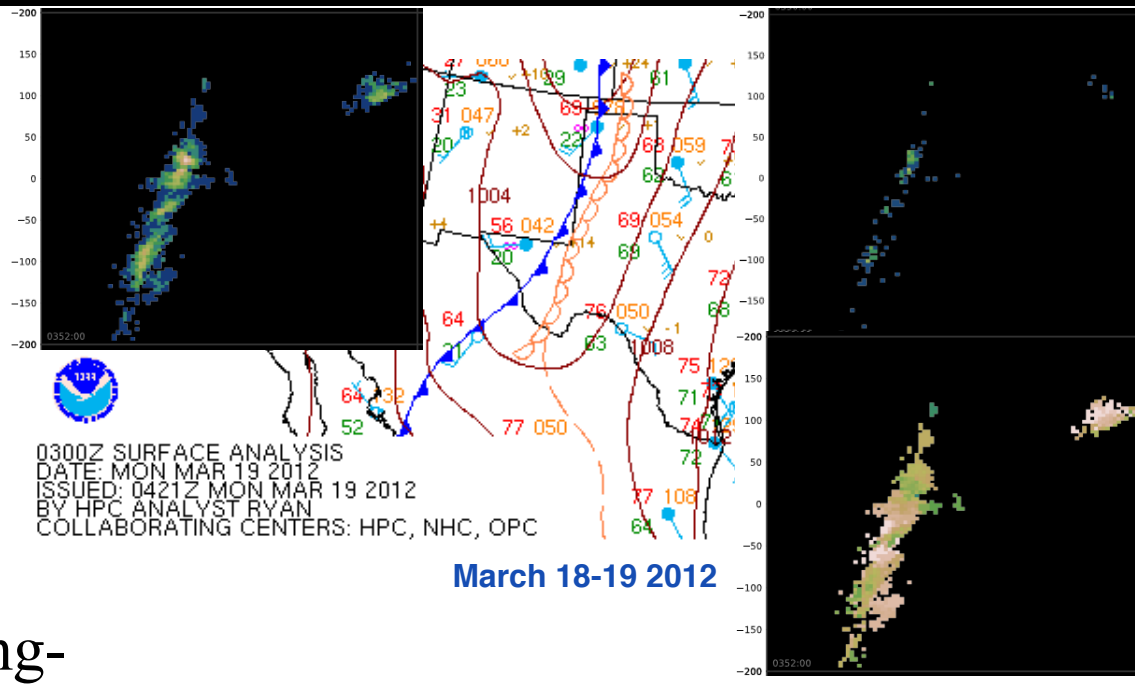
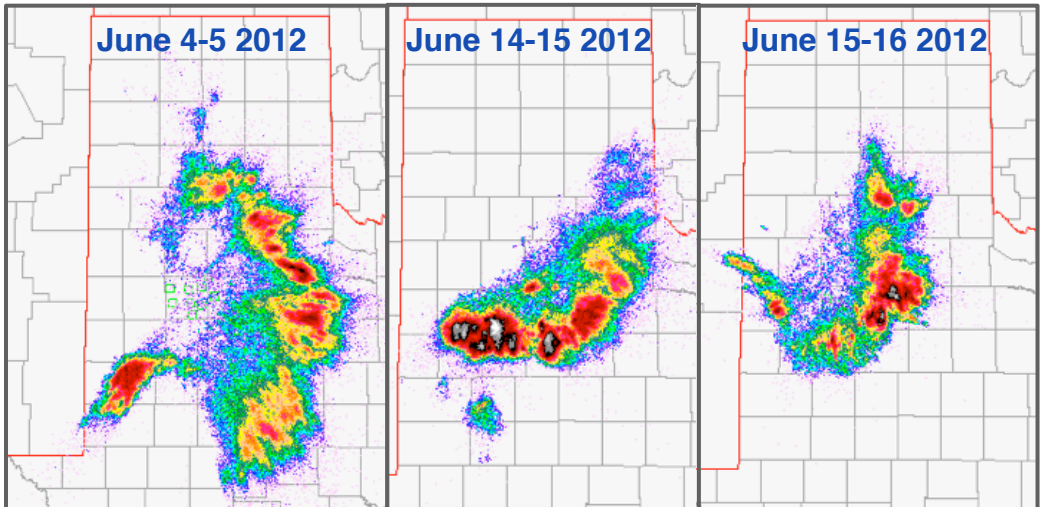


- Lightning variability in long-track MCSs over TX/OK
  - *Response to mesoscale environment*
  - *Storm polarity, electrification hypotheses of DC3*
  - *(V. Sullivan)*



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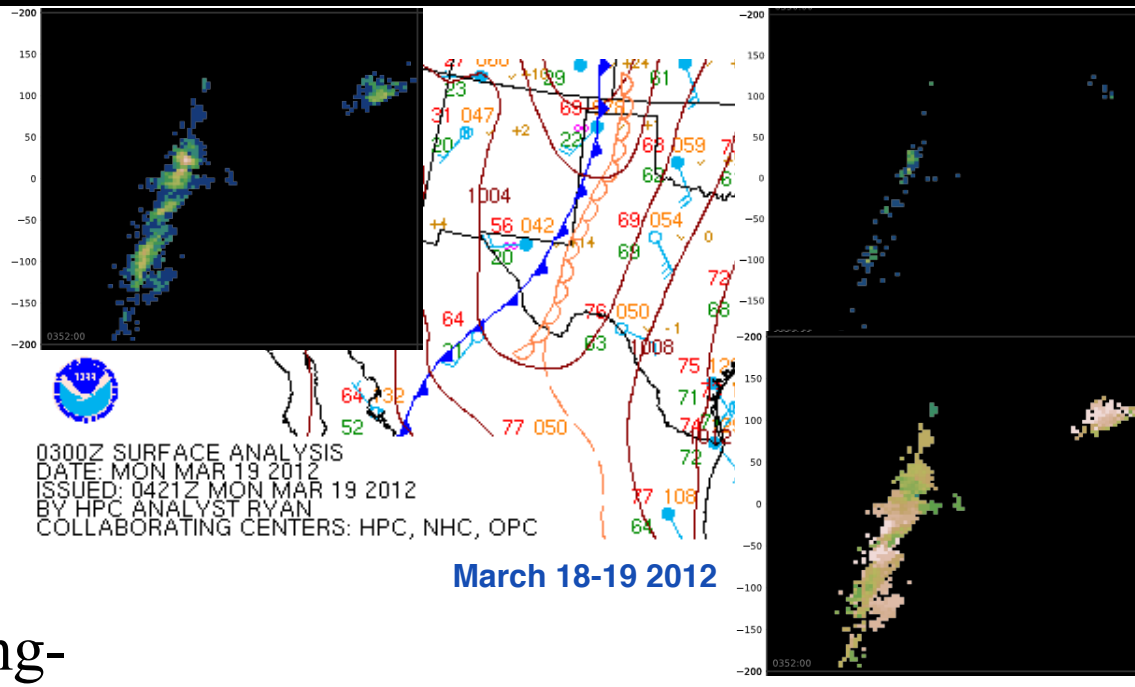

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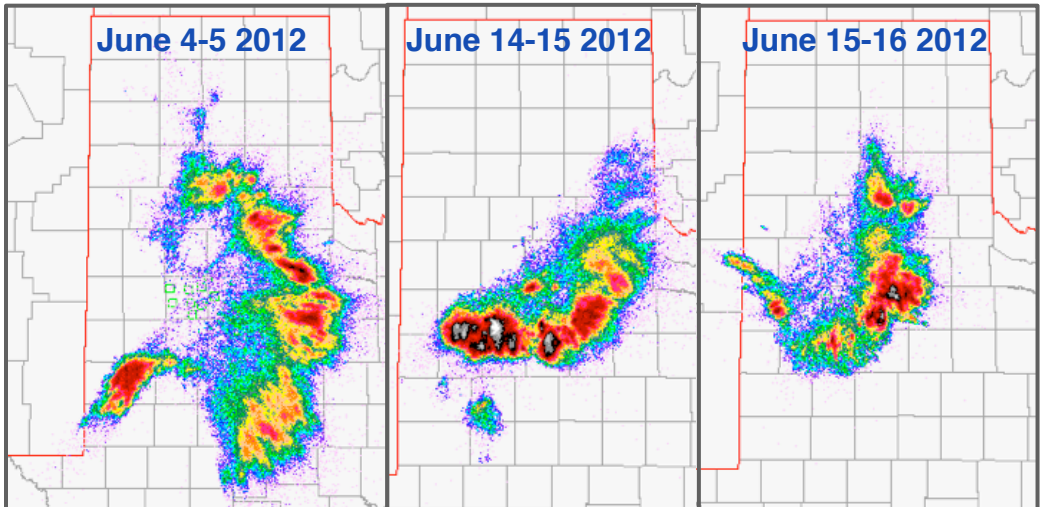

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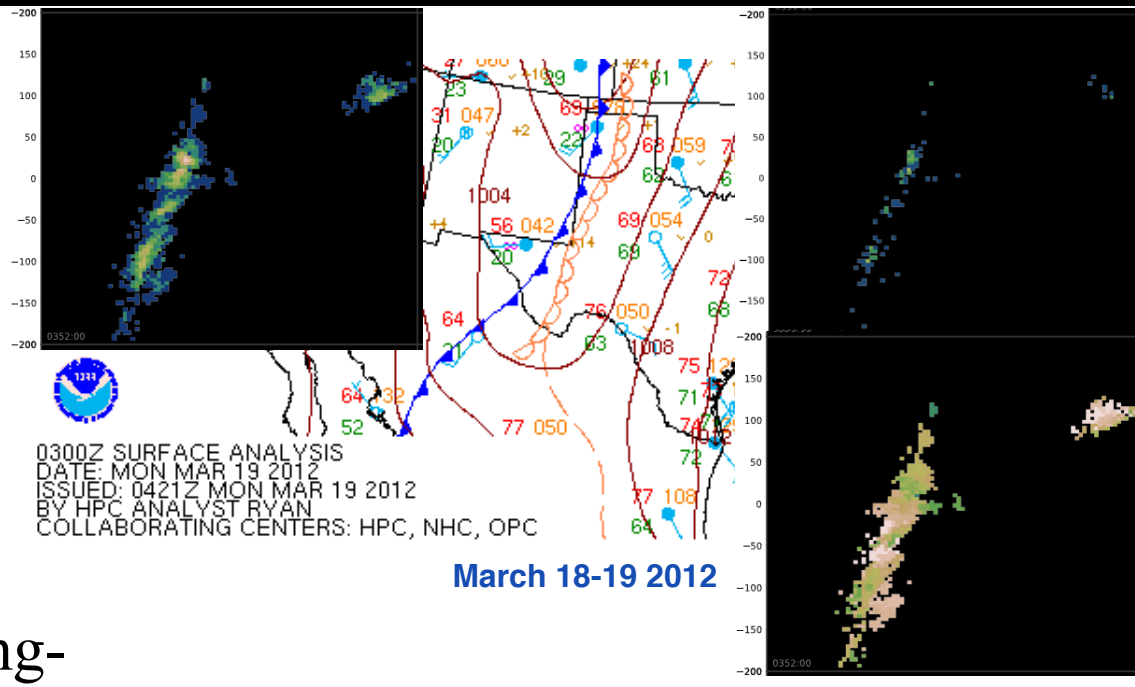

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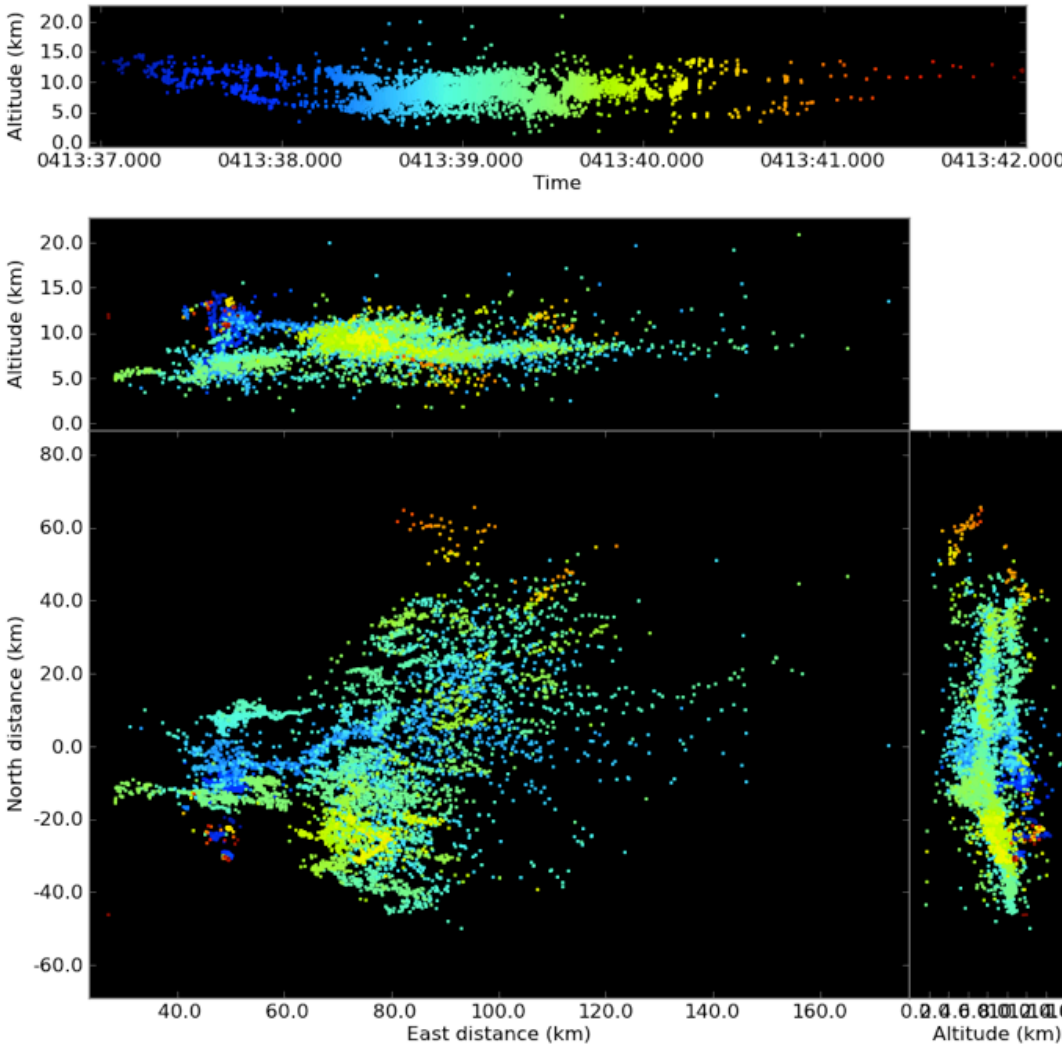
- Total lightning forecasting using WRF / McCaul et al. parameterization
  - *(J. Daniel)*

OTHER ONGOING RESEARCH

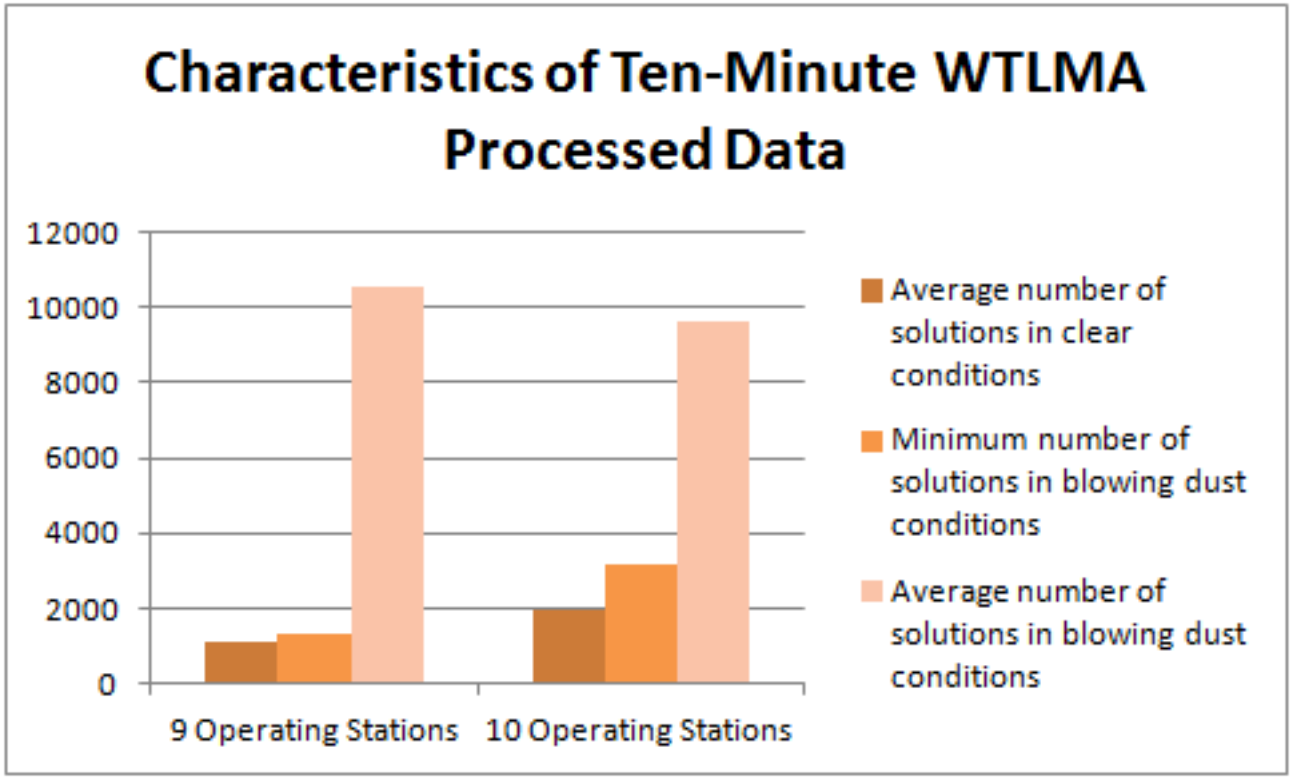
- In-kind support of DARPA sprite research
  - *TTU hosts Duke Univ. sprite camera and LF antenna*
  - *Sprite-parent discharges mapped by WTLMA, imaged by cameras in NM, CO, TX*
  - *Obs from 15th floor of Overton Hotel, late May 2012*
- Hosting LASA antenna
- TTU has sensors for dense (LMA-like) deployment of 12 Earth Networks Total Lightning sensors

100x100 km supercell anvil flash and sprite parent, 30 Apr 2012



IMPACT OF ELECTRIFIED DUST ON WTLMA

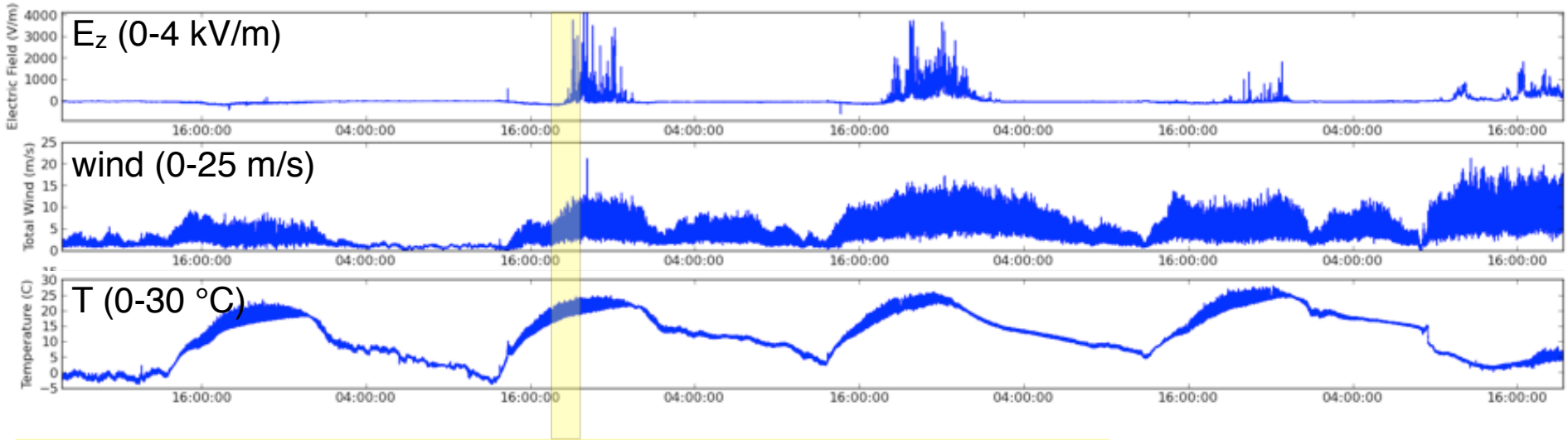
- Dusty conditions exhibit more scattered false sources
  - *Larger quantity of above threshold triggers*
  - *Corona discharge near sensors?*

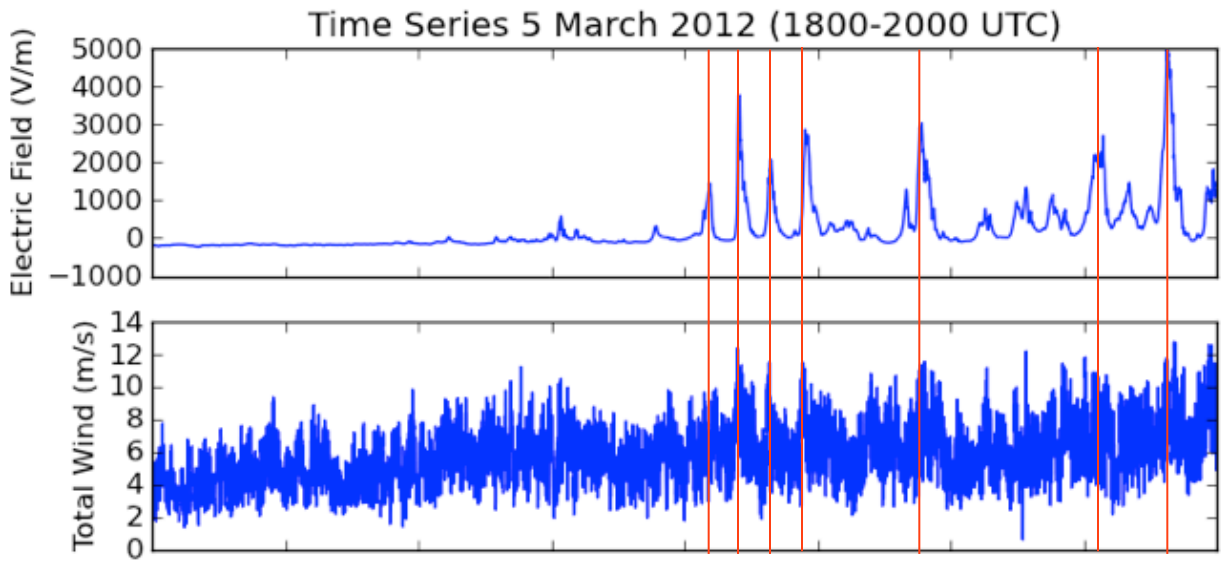


Total number of sources in data file, no filter for chi^2, number of contributing stations. All days had no lightning.

credit: V. Sullivan

ELECTRIC FIELD AND WINDS, 4-8 MARCH 2012





Data from CS110 E field meter and sonic anemometer (both 1 Hz) show covariance with wind speed, including gusts

(credit: V. Sullivan)